Site 427 Route 1A Bridge over the Parker River

Overview: The Route 1A Bridge crossing over the Parker River is located approximately 1.5 mi west or upstream of Plum Island Sound. The existing bridge is a 5-span concrete bridge that was constructed in the 1930's. The bridge is in very poor condition and is currently being redesigned for MassHighway. As the bridge lies near the mouth of a major tidal estuary, there are approximately 1,900 ac of tidal wetlands upstream of the crossing which could be affected by a restriction in tidal flows beyond the bridge. Other sites included in this rapid assessment study which could benefit from an increase in tidal exchange upstream of the bridge crossing include: Site 54-Red Gate Marsh, Site 60-Stilts Pond, Site 276-Kent's Island Creek, and Site 280-Newman Road. This nonstandard assessment consisted of tide monitoring, survey, site investigations, and review of the proposed bridge design and hydraulics, and an assessment of the feasibility of increasing tidal exchange.

There were two deployments of tide gauges: one from May 3 to May 17 and the other from August 11 to September 9, 2005. At each deployment, two tide gauges were installed: one upstream and one downstream of the bridge. Results of the May deployment show a consistent small restriction over the 27 tidal cycles recorded at the bridge. The restriction becomes slightly more pronounced as the tidal prism increases. Restrictions range from 0.30-0.41 ft and delays are all less than 10 min except for May 7 when the delay was 17 min. The highest tide (and largest measured tidal dampening) during the deployment period was on May 8 at 12:50 AM. The NAVD 88 adjusted height downstream of the bridge was 6.95 ft. The upstream adjusted height was 6.54 ft and occurred at 12:57 AM. The restriction caused a tidal dampening of 0.41 ft upstream of the bridge and a delay of less than 10 minutes. The dampening amounted to approximately 4.3% of the total tidal prism recorded at the downstream gauge. Measured salinities were 2.0 ppt downstream and 2.3 ppt upstream of the bridge on a near slack ebbing tide.

Results of the August/September deployment show a similar small restriction over the 52 tidal cycles recorded. The restriction becomes slightly more pronounced at the higher tides. Restrictions range from 0.23-0.31 ft and delays are all less than 10 min. The highest tide during the deployment period was on August 21 at 1:36 AM. The NAVD 88 adjusted height of the water downstream of the bridge was 6.73 ft. The upstream adjusted height was 6.43 ft which occurred at 1:45 AM. The restriction caused a tidal dampening of 0.30 ft upstream of the bridge. The dampening amounted to less than 3.2% of the total tidal prism recorded at the downstream gauge. The restriction on August 20 during the morning tide was slightly greater at 0.31 ft. The relatively uniform restriction recorded during both deployments was unusual. However, it appears to be a real phenomenon and not a survey or calibration error. A restriction of 3 to 5 in was also consistent with the biological benchmark data collected from both sides of the bridge.

Structure Conditions: The existing bridge over the Parker River is a 5-span concrete bridge that was constructed in the 1930's. The bridge is in very poor condition and is currently being redesigned for Mass Highway by the ASEC Corporation in Burlington, Massachusetts. The project is currently out for bid and construction was last scheduled to begin in the spring of 2006 and last for 1,400 days (3-years and 10-months).

The proposed bridge is a complete replacement of the existing bridge with a 3-span concrete bridge. The proposed design includes complete removal of the 4 existing piers. The new abutments consist of a bearing cap placed on top of drilled shafts. Gautam Sen, MassHighway Project Expediter, stated that this abutment type was chosen for its constructability, cost savings (when compared to a gravity abutment), and its reduced impact to the surrounding environment. The existing abutments have to remain in place for soil retention. By removing two of the

existing piers the proposed bridge's hydraulic opening is approximately 4 m (13 ft) or 4% wider than the existing bridge.

Construction Logistics/Feasibility: There are limited practical opportunities for increasing the bridge hydraulic opening beyond MassHighway's current design. One option would be to revise the current design such that the existing abutments could be removed to channel bottom (the remaining portion of the abutments could remain as scour protection). This would require that the proposed drilled shaft supported stub abutments be revised to full height gravity-type abutments. Construction of these abutments would require mobilization of additional specialized construction equipment, installation of cofferdams in the river, and possibly revisions to the construction and traffic control phasing. This revision would increase the hydraulic opening width by 16 m (39 ft) or 17% when compared to the existing bridge, or 13% when compared to MassHighway's design.

Another option for increasing the hydraulic opening would be to hold the northern pier location, shift the northern abutment 15 m (49 ft) to the north and remove the approach fill along the northern bank of the Parker River. To do this the northern abutment would again have to be changed to a gravity style abutment and the northern span would have to be modified. This modification would increase the hydraulic opening width by 19 m (62 ft) or 21% when compared to the existing bridge or 16% when compared to MassHighway's design.

Implementing either of these revisions would require or impact the following:

- *Bridge Design Revisions:* It is estimated that Design revisions would take up to approximately 2 months and could as much as $150,000 in consulting fees.
- *Amended permits:* It would take approximately 4 months to obtain revised permits and could cost up to approximately $ 50,000 in consulting fees, including section 404 water quality certification, Coast Guard approval, local order of conditions, and Chapter 91 license.
- *Revised hydraulic modeling:* The increased bridge opening may increase upstream storm flooding and affect FEMA's Flood Insurance Rate Maps. If so, it would require a Letter of Map Revision. Hydraulic modeling for the proposed bridge was done by MassHighway so additional time and costs cannot be estimated.
- *Construction Schedule:* Construction may be delayed by a minimum of 1-year. The bridge is currently failing and is a safety hazard to boaters (MassHighway has received complaints about falling debris). A delay in construction will further increase safety problems and concerns. Construction cost could increase by approximately 5% of the total bridge cost to account for project delays and inflation, plus the additional costs associated with the design revisions. Additional construction costs associated with the design revisions are unknown; however, they are dependant on the following:
    - Additional cofferdam and dewatering requirements.
    - Addition sheet piling to facilitate the construction of full height abutments.
    - Additional material costs (full height abutments require much more concrete than drilled shafts).
    - Changes to the girder sizing, and spacing (An increased span may require a larger beam, or additional beams).
    - Construction phasing / traffic control revisions.

In general, the MassHighway design improves the flow pattern and hydraulic capacity of the bridge so a reduction in the existing restriction is anticipated. However, the improvement is difficult to accurately model and would require a significant two-dimensional modeling. The current MassHighway modeling was developed to aid in scour protection design and was not

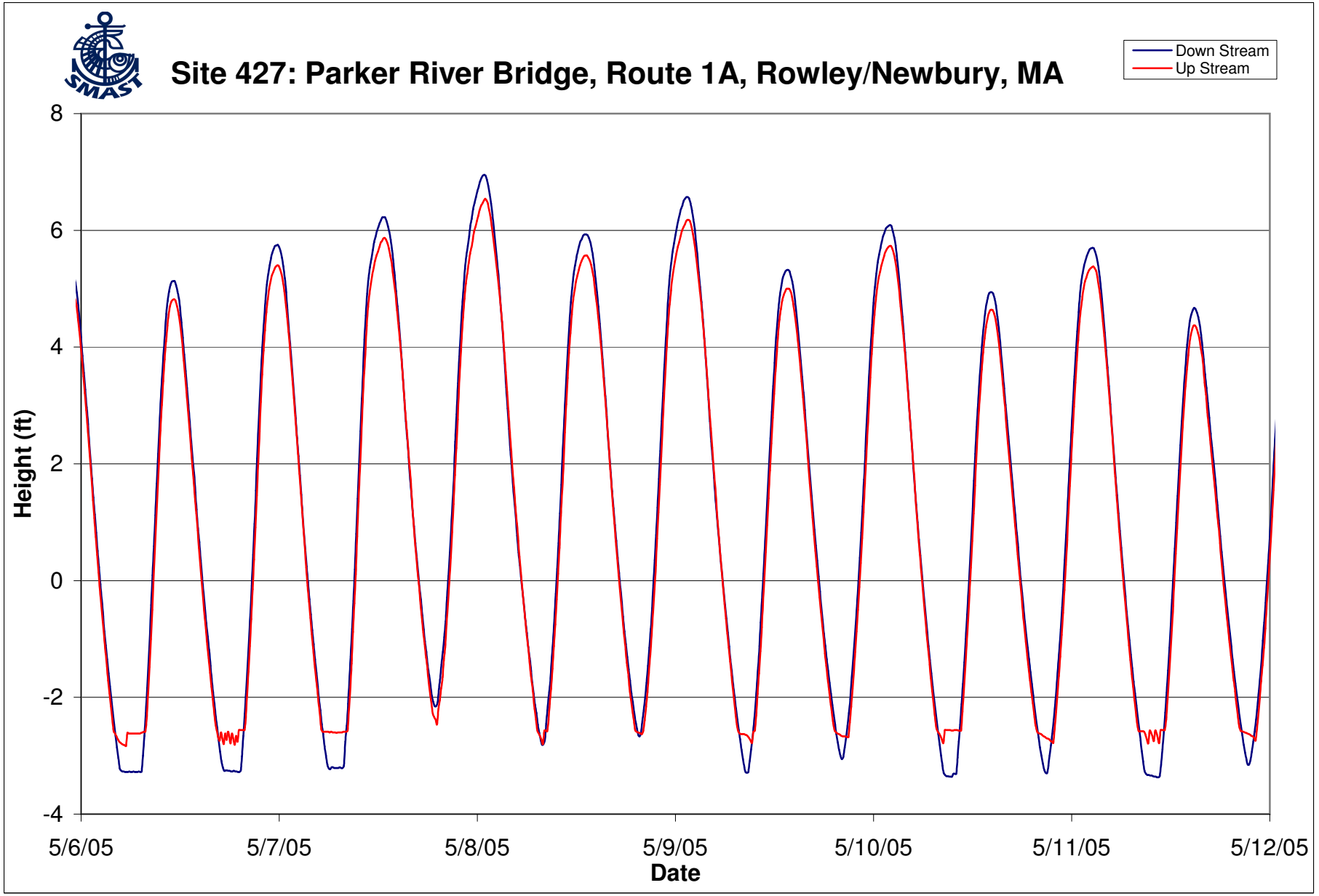
intended to model tidal restrictions. Given the status of the project (currently advertised for construction), any project design changes at this time would likely impact the construction schedule and costs associated with an important infrastructure project.

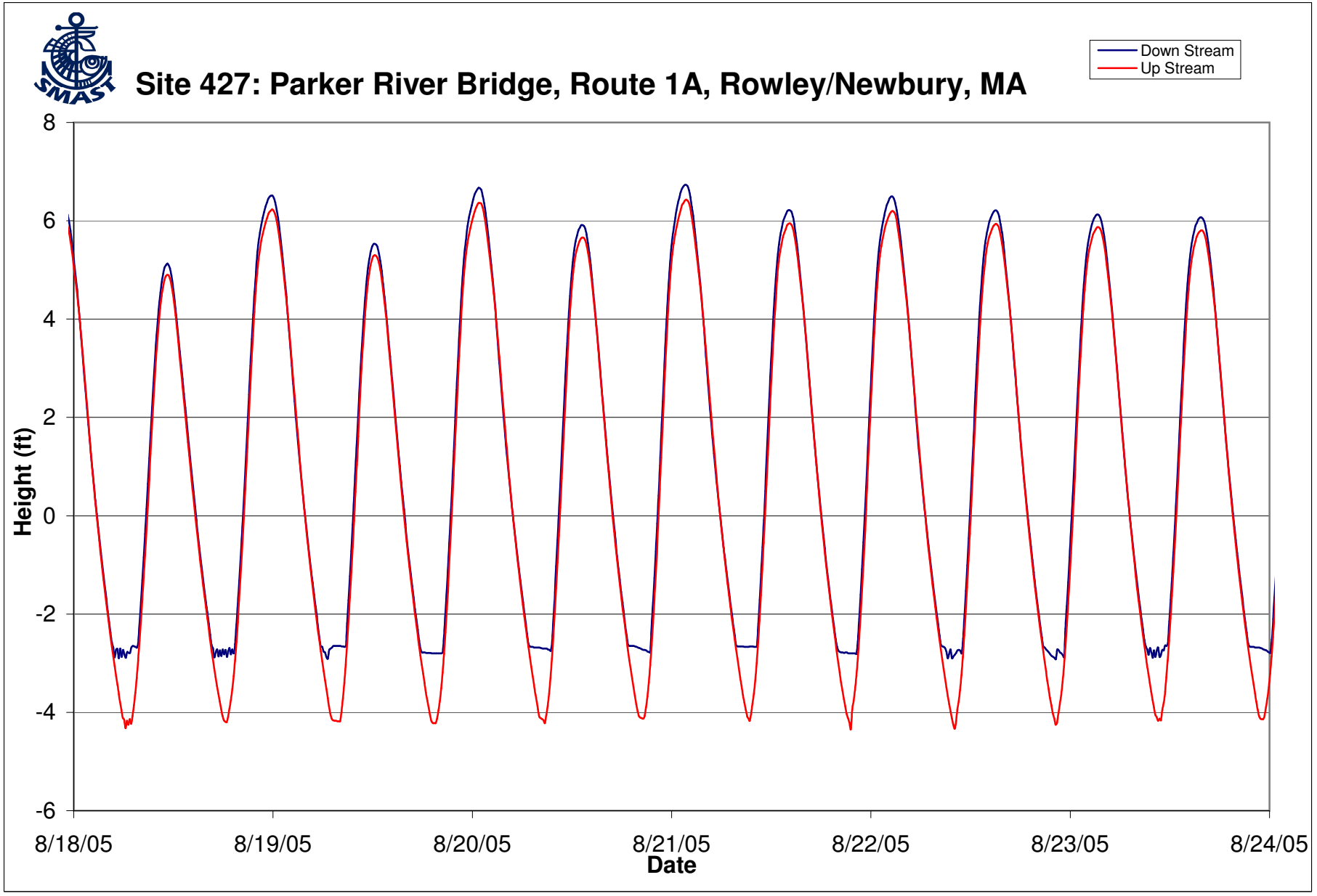

Site # 427
Site Features
Scale: 1:2,000
TBM2
6.9
TBM4
11.2
HM4
HM3
5.3
TBM3
7.6
TBM1
9.3
LM2
4.3
LM3
4.7
LM1
4.3
HM1
5.4
HM2
5.2
TBM5
9.3
HM6
5
LM6
4.4
HM7
5
HM8
5
LM4
3.7
HM5
5.1
LM5
4.2
August Gauge Location
May/August Gauge Location
May Gauge Location
Route 1A Bridge
Parker River
N
1
2
3
Datum: NAVD 88
Potential Restoration Site
Photo Locations
Tide Gauges
Benchmark
Ground Elevation

Photo 1 - Downstream View of Bridge

Photo 2 - Downstream Marsh at Northern Approach

Photo 3 - Upstream Marsh along River Bank


Site 427: Parker River Bridge, Route 1A, Rowley/Newbury, MA
Down Stream
Up Stream
Height (ft)
8
6
4
2
0
-2
-4
5/6/05
5/7/05
5/8/05
5/9/05
5/10/05
5/11/05
5/12/05
Date


Site 427: Parker River Bridge, Route 1A, Rowley/Newbury, MA
Down Stream
Up Stream
Height (ft)
8
6
4
2
0
-2
-4
-6
8/18/05
8/19/05
8/20/05
8/21/05
8/22/05
8/23/05
8/24/05
Date